



# DATA ANALYTICS USING IOT IN PROCUREMENT

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## ABSTRACT

The paper describes the application of data analytics and Internet of things in procure to pay process. The procurement process till date was manual and hence prone to errors. Moreover, with the current increasing demand, handling procurement process manually has become an arduous task. Thus, the whole process of procurement to pay can be automated using machine learning algorithms and Internet of Things. A use case of "Warehouse Inventory Management" is considered to put forth the idea. The paper proposes a model of computerization of the "procure to pay" process which increases efficiency and in turn raises profit. The sensor is used to know when to raise a request for purchase order and collects data from SKU master data to gain an insight of total number of certain goods. The SKU (stock keeping unit) identifies each item in the warehouse uniquely eg. SKU can be a bar code number. All the manual processes are supplanted with the systems which learn from the dataset provided, analyze, draw insights and take intelligent decisions.

**KEYWORDS:** procure to pay, data analytics, inventory control, vendor selection, SKU (stock keeping unit), Warehouse Inventory management.

## I. INTRODUCTION:

Procurement refers to the acquisition of goods from suppliers. After procuring them, they need to be stored in a warehouse. The goods here are referred to as inventory. As the volume of these operations is on the rise in today's world, there is an increasing demand for more automation and lesser manual effort to enable businesses make better and intelligent decisions. There are also several ways in which analytics can be used to gain insights into the ways in which current processes related to procurement and inventory control can be improved. This paper attempts to explore methods to make such improvements.

The three questions are addressed in the paper:

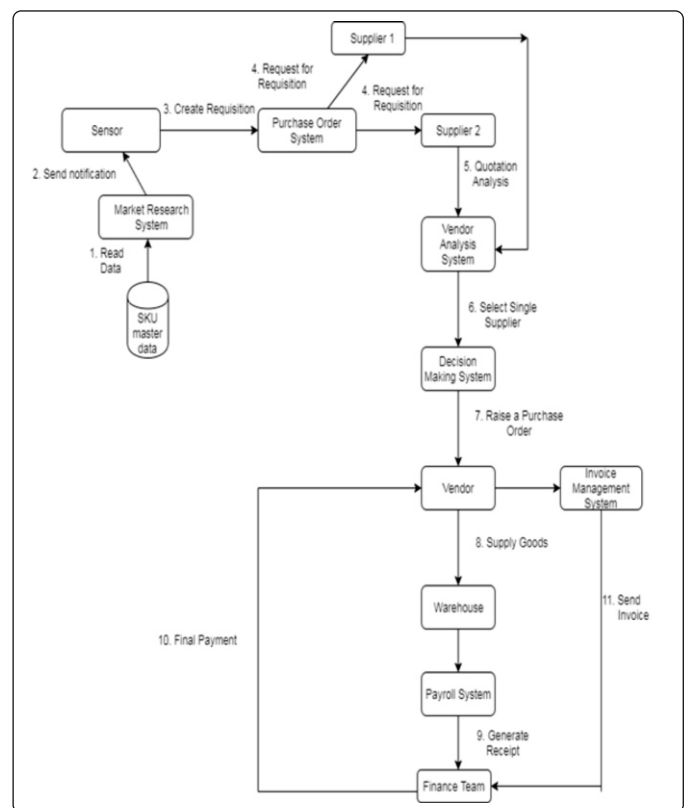
- 1. When to purchase (Inventory control):** The need to raise a purchase order arises when the quantity drops below certain threshold. With the current increase in the demand, the manual work of keeping record of the inventory and on reduction of the goods, raise a purchase order becomes an arduous task. So, as a part of this paper, the database is maintained and market research system keeps a record of inventory and when count decreases, the notification is sent to the sensor which asks purchase order system to create a requisition.
- 2. From whom to purchase (Supplier selection):** The need for the purchase order leads to sending request for the requisition to the different suppliers. Now, if there are some suppliers which have tie-ups with the warehouse, the warehouse can certainly select them with not much analysis. However, if the suppliers to be selected are for the very first time, then selecting handful of suppliers for requesting requisition manually will be strenuous task. The purchase order system defined in the proposed model will take care of this task. By feeding large dataset of suppliers, the machine will gradually learn and will send request for requisition to the handful of suppliers. The suppliers will then reply with quotation. The vendor analysis system will select one supplier. Thus, this shows that how automating this process will accelerate the work.
- 3. How much to purchase (Inventory control):** In order to select supplier, the analysis of every suppliers quotation needs to be done meticulously. A small error might change supplier selected altogether and can lead to loss. The selection is based on variety of factors viz. cost, reputation etc. Considering all the parameters at once might get intricate when did manually. The vendor analysis system thus, takes care of the analysis in automated model. Based on the dataset fed, the machine will learn, analyse and come up with solution. The machine learning algorithms applied on the dataset will also enable us to know how much inventory to purchase. Thus, purchase order system, vendor analysis system and market research system collate to form decision making system which takes intelligent decisions.

## II. PROPOSED MODEL:

The Model is based on procure to pay process.[4]

## III. DIAGRAM:

The diagram denotes application of Internet of Things in the "Procure to pay" process in "Warehouse Monitoring System". The diagram explanation is as follows:



- 1. SKU Master Data:** The stock keeping unit (SKU) master data will have metadata of each and every inventory in the warehouse. The database has following schema:

1. Name and details of the item in the inventory.
2. SKU i.e Id of an item in the inventory.
3. The initial threshold value of item after which an item needs to be ordered. The initial threshold will change as the market research system will learn and calculate threshold based on various factors gradually.
4. Duration after which new order was initiated
5. Quantity of New item ordered and supplier from which it was ordered.
6. A table for supplier with columns of basic information of the supplier from quotation, quantity and SKU of items ordered, the count of number of times the quantity was ordered from supplier, turnaround time to receive order.
7. A table for invoice. The invoice amount of the item paid to the supplier,

invoice number, date of invoice and invoice details.

8. An audit table for item, invoice as well as supplier to maintain history of transactions. This will act as dataset and will help all the systems to make intelligent decision based on insights.
2. **Market Research System:** Market Research System will read data from SKU master data whenever the quantity goes below initial threshold value. This threshold values will act as a dataset and the system will be trained. The threshold value will thus change once system is trained. The market research system will send a notification signal to the sensor as soon as it detects that there is need to order items. The market research system will work to forecast the demand of the warehouse. The large scale effect would be to predict the decrease in the quantity in advance and place order.
3. **Sensor:** The sensor receives the notification signal from Market Research System. On receipt of signal, the sensor asks purchase order system to create requisition. The sensor will take input from different sources and collect data from the inventory to find total number of certain goods etc.
4. **Purchase order System:** The purchase order system on receiving signal of create requisition, initiates a Requisition Request to different suppliers or vendors. The suppliers will then reply with quotation. The quotation will have information of price, quantity, description etc. The supplier selected can be from the existing list from database or can be new suppliers decided by the warehouse. Based on the master database, the purchase order system will send requisition request to suppliers.
5. **Vendor analysis System:** All the suppliers reply with their respective quotation. The quotations are fed to vendor analysis system for quotation analysis. The vendor analysis system performs analysis and selects one supplier. The selection of vendor is done based on factors as noted below[1]:
  1. Financial Strength
  2. Vendor business model
  3. Capacity to supply the appropriate products and services.
  4. Capabilities – what it can and cannot do or provide.
  5. Turnover and profit levels.
  6. Mark-ups, price list and discounts.
  7. Reliability and quality.
  8. Reputation.
  9. Payment terms.
  10. Deliveries.
  11. Ability to implement a solution if services are being purchased.
  12. Availability of experienced staff.
6. **Decision Making System:** The decision making system is made up of market research system, purchase order system and vendor analysis system. The selected supplier information is passed to decision making system to generate a purchase order to the vendor. The decision making system will draw out insights about the supplier based on the supplier selected by vendor analysis system.
7. **Vendor:** On receiving the Purchase Order request, the vendor will then supply goods to the warehouse. The warehouse will provide receipt to the payroll system.
8. **Payroll system:** Warehouse will generate receipt through payroll system and give it to financial team. The finance team will analyse the receipt and post confirmation of the receipt, the final payment will be made to the vendor.
9. **Invoice Management System:** The invoice management system will generate invoice for vendor on receipt of final payment from the finance team.

#### IV. CHALLENGES AND ROADMAP FOR ADOPTION:

**5.1 Challenges:** To develop a new solution to solve existing issues or modify existing system for betterment of the society is followed by many challenges. The solution here is to replace manual tasks by the automated systems. The challenges faced while making procure to pay system automated are discussed below:

**5.1.1 Migration from traditional to new systems:** The traditional system was mostly comprised of paper work with moderate use of computer. The error in anyone of the document would lead to reiterate the process from that point till end. The new systems would minimize such errors. However, the major challenge lies in the migration. The time and resources required for the setting up the software and hardware (sensor) will be considerable. The setting up new systems will cause additional money which would be one time installation cost.

**5.1.2 Human Resources / Talent Acquisitions:** The new systems involve machine learning capabilities and hardware engineers for the sensors. This will give rise to plethora of employment opportunities. The machine learning technology is in a fairly nascent stage in India but there are moderate employees with these skills, especially the freshmen. This would also mean to train existing people about the use of new systems.

Although, this would need considerable time and money but this would set a firm base for the future and in turn would increase profit drastically. In addition, the turnaround time will be reduced thereby increasing the efficiency of the warehouse.

**5.2 Roadmap:** In order to migrate to the new system, the following things on the roadmap need to be followed:

**5.2.1 Installation of Sensors:** Since the sensor would be driving the process, the sensors need to be installed first. The installation of sensors would need circuits and hardware engineers.

**5.2.2 Software Setup:** The software setup includes installing the software on the computers. All the systems in the diagram viz. purchase order system, market research system, vendor analysis system, decision making system, payroll system and invoice management system need separate software to perform their tasks. The software required by each of the system needs to be installed.

**5.2.3 Feeding algorithms for different SKUs to place purchase order:** Since the systems are machine learning systems, different algorithms are required to be fed them. The market research system will need a different algorithm than a vendor analysis system. The dataset also needs to be generated to train the machine learning systems.

**5.2.4 Testing systems thoroughly:** The system needs to be tested thoroughly post installation. The testing includes generating a dataset of all kinds and feeding to machine learning systems to test the responses. The sensors need to be tested in the extreme situations at all the voltage ranges, current flow rate and power fluctuations.

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